

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
28 November 2002 (28.11.2002)

PCT

(10) International Publication Number  
**WO 02/094490 A1**

(51) International Patent Classification<sup>7</sup>: **B23G 1/16**,  
5/06, 7/02

(21) International Application Number: PCT/SE02/00980

(22) International Filing Date: 22 May 2002 (22.05.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
0101812-6 22 May 2001 (22.05.2001) SE

(71) Applicant (for all designated States except US): **SAND-  
VIK AB** [SE/SE]; S-811 81 Sandviken (SE).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **HÅKANSSON, Björn**  
[SE/SE]; Pumpvägen 12, S-302 30 Halmstad (SE).

(74) Agents: **ALBIHNS STOCKHOLM AB** et al.; P.O. Box  
5581, S-114 85 Stockholm (SE).

(81) Designated States (*national*): AE, AG, AL, AM, AT (utility model), AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ (utility model), CZ, DE (utility model), DE, DK (utility model), DK, DM, DZ, EC, EE (utility model), EE, ES, FI (utility model), FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK (utility model), SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

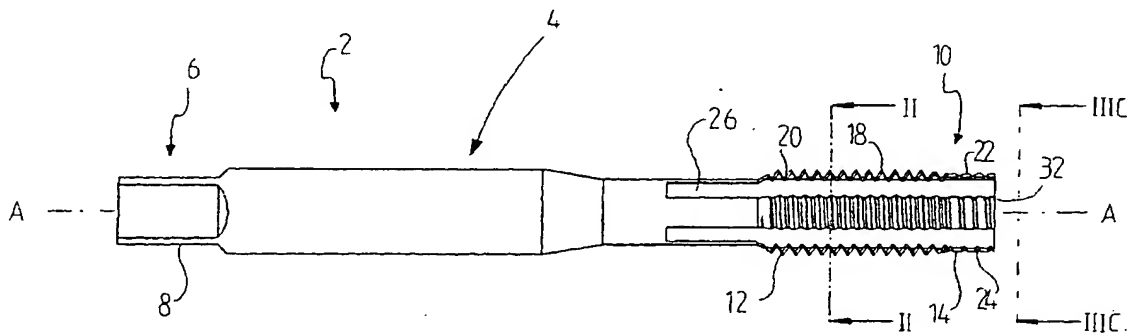
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A THREAD FORMING TAP WITH A NON-CIRCULAR CROSS-SECTION AND RADIALY EXTENDING CUTTING EDGES



(57) Abstract: A thread forming tap comprises an elongated body (4), having at a first end (6) a connector portion (8) and at a second end (10) a thread forming portion (12), said thread forming portion comprising at least one thread forming thread (18) having a non-circular cross-section including at least three lobes (30) for plastically deforming an interior wall of an opening while forming an internal thread. According to the invention, at the open end (32) of the elongated body (4), at least one radially extending edge (34) is provided for cutting parts of the interior wall of said opening.

WO 02/094490 A1

A thread forming tap with a non-circular cross-section and radially extending cutting edges

## TECHNICAL FIELD OF THE INVENTION

5 The present invention relates to a thread forming tap comprising an elongated body, having at a first end a connector portion and at a second end a thread forming portion, said thread forming portion comprising at least one thread forming thread having a non-circular cross-section including at least three lobes for plastically de-  
forming an interior wall of an opening while forming an internal thread.

10

## TECHNICAL BACKGROUND

Such a thread forming tap is known from EP-A-0 767 024. That kind of tap is how-  
ever disadvantageous, as it can barely be used for other openings than circular cy-  
lindrical holes.

15

## SUMMARY OF THE INVENTION

The object of the invention is to achieve an improved thread forming tap.

20

This has been achieved by the tap of the initially defined kind, wherein at the open end of the elongated body, at least one radially extending edge is provided for cutting parts of the interior wall of said opening.

25 Hereby is achieved a thread forming tap that pre-forms an opening to a form suitable for thread forming, which in turn extends the working life of the tap, since better thread forming conditions are achieved.

Preferably, said edge extends substantially from the central axis of said elongated  
30 body. Hereby, efficient forming of e.g. conical blind holes is achieved.

Suitably, a thread relief portion is provided between said thread forming portion and said open end, said relief portion being provided with a thread having a cut ridge having a substantially circular cylindrical form and being divided by a helical groove for allowing turning the tap away from said opening. Hereby, easy removal of the tap after thread forming is allowed.

Preferably, said cut ridge has a diameter smaller than the largest diameter of the thread forming thread, and wherein said groove has a diameter slightly smaller than the diameter of the cut ridge.

Advantageously, the diameter of the thread of the thread forming portion increases from the level of the cut ridges of the relief portion. Hereby, thread forming is made possible.

Suitably, at least one flank portion extending substantially radially from the axis of the body defines a flute extending substantially in a longitudinal direction of the body and through said thread forming portion, said thread forming thread thereby being cut into a discontinuous thread. Hereby chip removal and supply of cooling fluid supply is allowed.

In particular, said flute is substantially straight. Alternatively said flute is helically shaped about the circumference of said body.

#### DRAWING SUMMARY

In the following, the invention will be described in more detail by reference to the accompanying drawings, in which

Figure 1 illustrates a thread forming tap,

Figure 2 is a cross-section along the line II-II in figure 1

Figure 3a is a perspective view of the tap shown in figure 1,

Figure 3b is an enlargement of the portion within the circle shown in figure 3a,

5 Figure 3c is a front view of the tap shown in figure 1,

Figure 4 illustrates an alternative thread forming tap.

## DETAILED DESCRIPTION

10

Figure 1 shows a thread forming tap 2, comprising an elongated body 4 having an axis A-A. The elongated body 4 has at a first end 6, a connector portion 8 and at a second end 10 a thread forming portion 12, and a thread relief portion 14. The tap 2 is preferably made of a high speed steel or a solid carbide material. The connector portion 8 is adapted to be connected to a tool holder of a drilling or milling machine.

15

20

The thread forming portion has a thread forming thread comprising a ridge 18 separated by a helical groove 20. The diameter of the thread 18 increases from the relief portion 14 towards the second end 8 and after a few pitches, the diameter is constant (however not circular, see below).

25

The thread relief portion 14 is provided with a helical thread having a cut ridge 22 separated by a helical groove 24. The cut ridge 22 has a smaller diameter than the largest diameter of the thread forming thread 18 and the groove 24 has a diameter slightly smaller than the diameter of the cut ridge 22. The pitch of the thread 22 and the groove 24 of the thread relief portion 14 is the same as in the thread forming portion 12. The thread forming portion allows for turning the tap away from said opening after performed thread forming operation.

30

The threads 18 and 22 are separated in the longitudinal direction of the body 4 by four flutes 26 (see also figure 2). The flutes 26 are thus defined by four flank portions 28. At the periphery of each flank portion 28, the thread 18 and 22 is arranged,

respectively (in figure 2, only the flank portions of the thread forming portion 12 can be seen). The purpose of the flutes 26 is to allow supply of a cooling fluid and to allow removal of chips.

5 The four flutes 26 divides the thread 18 into pieces of a thread, the pieces of thread thus forming a discontinuous or virtual thread. The same relates to the thread 22.

The thread 18 of the thread relief portion is non-circular (see figure 2). Instead, each flank is provided with a pointed thread part, each forming a lobe 30 for plastically  
10 deforming the interior wall of a hole while forming an internal thread.

As can be better seen in figure 3a – 3c, the first end 10 is provided at its open end 32 with four radially extending cutting edges 34 for cutting non-circular cylindrical holes. Cast blind holes are generally not circular cylindrical, but may be slightly  
15 conical due to the casting process. The cutting edges 34 are thus utilised for forming the non-circular cylindrical holes to a circular cylindrical shape.

In figure 4, an alternative tap 4 is shown, the difference being that the flute 26 is somewhat helical, rather than straight.

20

## OPERATION

A thread is to be formed in a through hole or a blind hole of a non-circular cylindrical – in particular irregular - shape, respectively, e.g. in a moulded piece of metal.

25

The tap 2 is moved to the hole defined by a wall (not shown). During its introduction into the hole, the tap is turned and the cutting edges 34 cut the hole and form it to the predetermined circular cylindrical shape. The groove 18 enters the hole and the lobes 30 press the material of the wall at such a high pressure that it is plastically  
30 deformed and floats into the groove 20. A cooling fluid is introduced via the flutes 26.

When the thread forming operation is finished, the tap is turned in the opposite direction. The thread relief portion 14 facilitates withdrawal of the tap from the hole.

5 Of course, the number of flanks 28 and flutes 26 may be less than four, e.g. three, and more than four, e.g. eight.

Furthermore, the flanks 28 and flutes 26 may be helically shaped.

10 Furthermore, the number of threads may be more than one, i.e. a pair of parallel threads may be provided.

Furthermore, in figure 1, the shape of the thread relief portion is illustrated as circular cylindrical. However, it may instead be slightly conical, the largest part of the cone being at the open end 32 of the body 4.

15 Furthermore, the number of cutting edges may be less than four, e.g. one, or more than four, e.g. ten. However, it is advantageous to arrange the same number of cutting edges as the number of flanks.

## CLAIMS

1. A thread forming tap comprising an elongated body (4), having at a first end (6) a  
5 connector portion (8) and at a second end (10) a thread forming portion (12), said  
thread forming portion comprising at least one thread forming thread (18) having a  
non-circular cross-section including at least three lobes (30) for plastically deform-  
ing an interior wall of an opening while forming an internal thread, **characterised**  
10 **in that** at the open end (32) of the elongated body (4), at least one radially extend-  
ing edge (34) is provided for cutting parts of the interior wall of said opening.

2. A thread forming tap according to claim 1, wherein said edge (34) extends sub-  
stantially from the central axis (A-A) of said elongated body (4).

15 3. A thread forming tap according to claim 1 or 2, wherein a thread relief portion  
(14) is provided between said thread forming portion (12) and said open end (32),  
said relief portion (14) being provided with a thread (22) having a cut ridge having a  
substantially circular cylindrical form and being divided by a helical groove (24) for  
allowing turning the tap away from said opening.

20 4. A thread forming tap according to claim 3, wherein said cut ridge (22) has a di-  
ameter smaller than the largest diameter of the thread forming thread (18), and  
wherein said groove (24) has a diameter slightly smaller than the diameter of the cut  
ridge (22).

25 5. A thread forming tap according to claim 4, wherein the diameter of the thread  
(18) of the thread forming portion (12) increases from the level of the cut ridge of  
the relief portion.

6. A thread forming tap according to anyone of the preceding claims, wherein at least one flank portion (28) extending substantially radially from the axis (A-A) of the body (4) defines a flute (26) extending substantially in a longitudinal direction of the body and through said thread forming portion (12), said thread forming thread (18) thereby being cut into a discontinuous thread.
7. A thread forming tap according to claim 6, wherein said flute (26) is substantially straight.
8. A thread forming tap according to claim 6, wherein said flute (26) is helically shaped about the circumference of said body (4).



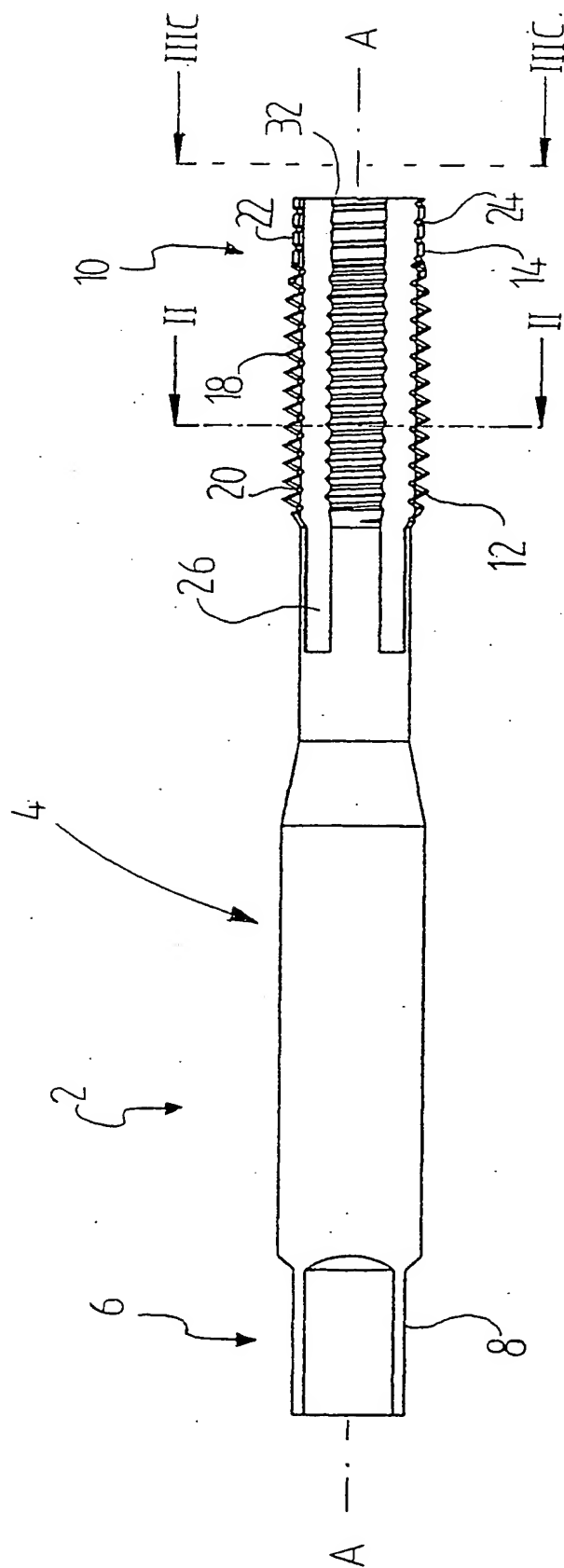


Fig 1

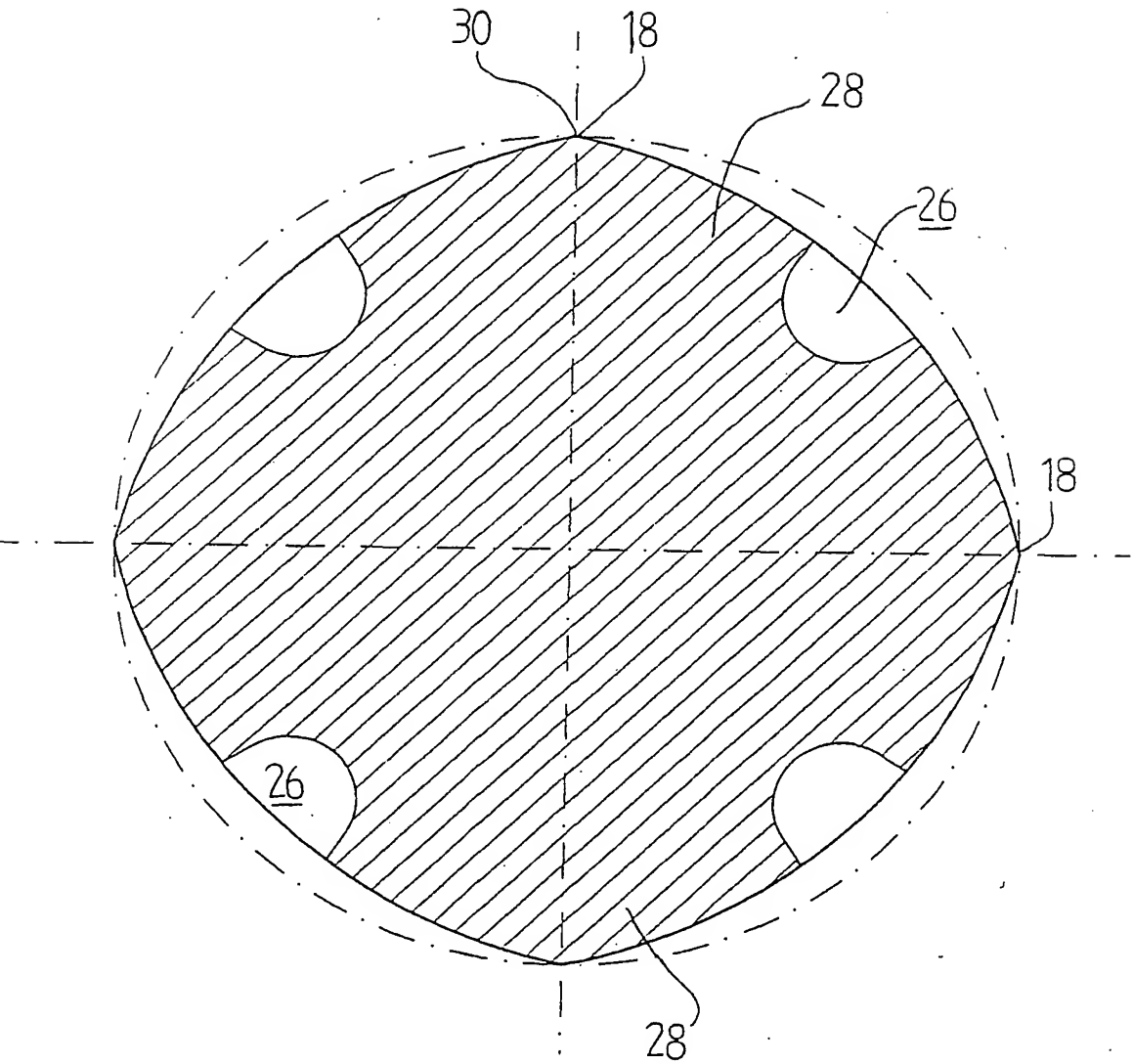


Fig 2

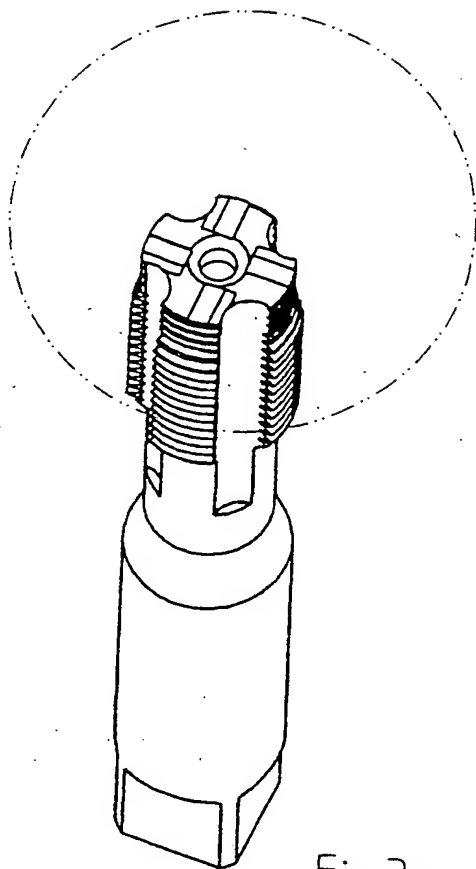


Fig 3a

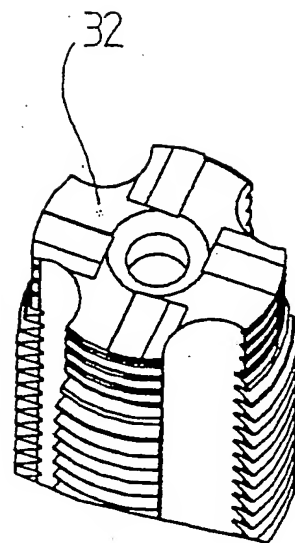


Fig 3b

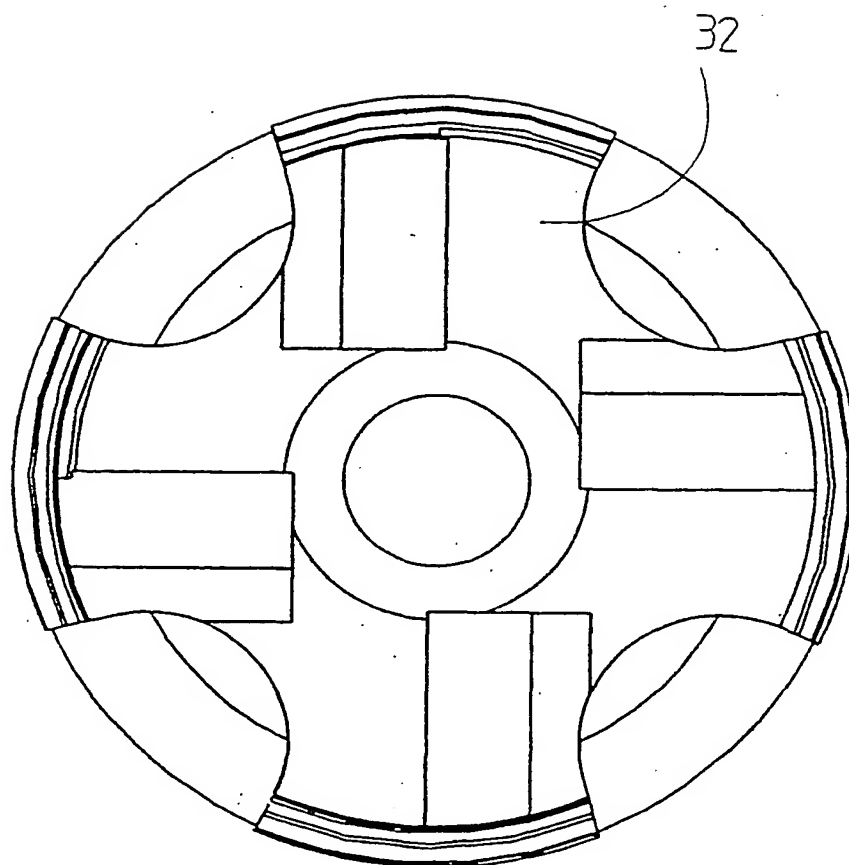


Fig 3c

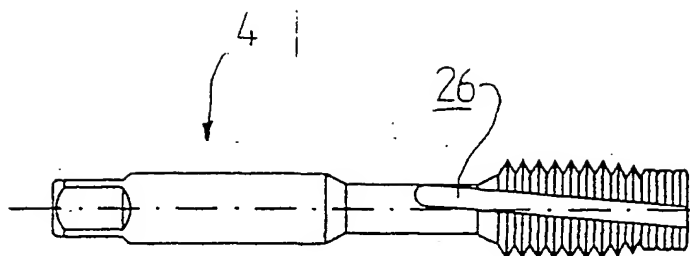


Fig 4

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 02/00980

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B23G 1/16, B23G 5/06, B23G 7/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B23G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI-DATA, EPO-INTERNAL, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 8915796 U1 (BUCHWALD, WILLI), 1 August 1991 (01.08.91), figures 1,2 --	1,2,6-8
Y	US 5725336 A (LASZLO VILMANYI ET AL), 10 March 1998 (10.03.98), figures 1,2, abstract --	1,2,6-8
A	DE 4003257 A1 (WILHELM FETTE GMBH), 8 August 1991 (08.08.91), figures 1,2, abstract --	1-6
A	US 5562371 A (GARY J REED), 8 October 1996 (08.10.96), abstract --	1-8

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

15 August 2002

Date of mailing of the international search report

02-09-2002

Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. +46 8 666 02 86

Authorized officer

Åsa Lööf/EK  
Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 02/00980

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 3307555 A1 (GÜHRING, GOTTLIEB), 13 Sept 1984 (13.09.84), abstract --	1-8
A	SE 505742 C2 (SANDVIK AB), 6 October 1997 (06.10.97), abstract --	1-8
A	EP 0767024 A1 (TANOI MFG CO LTD), 9 April 1997 (09.04.97), abstract --	1-8
A	EP 0953396 A1 (TANOI MGF CO LTD), 3 November 1999 (03.11.99), abstract -----	1-8

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SE 02/00980

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
DE	8915796	U1	01/08/91	DE 3934621 A,C	18/04/91
US	5725336	A	10/03/98	AU 673826 B	28/11/96
				AU 3903393 A	29/08/94
				DE 69322791 D,T	19/08/99
				EP 0683708 A,B	29/11/95
				FI 953807 A	10/10/95
				HU 131 U	28/10/93
				HU 9300019 V	00/00/00
				JP 8508683 T	17/09/96
				NO 303049 B	25/05/98
				NO 953130 A	10/10/95
				PL 171417 B	30/04/97
				PL 310121 A	27/11/95
				RO 112700 A,B	30/12/97
				RU 2098237 C	10/12/97
				AT 174831 T	15/01/99
				CA 2155962 A	18/08/94
				CZ 286052 B	15/12/99
				CZ 9502052 A	15/05/96
				HU 68970 A	28/08/95
				HU 214896 B	28/07/98
				HU 9300345 D	00/00/00
				WO 9417946 A	18/08/94
DE	4003257	A1	08/08/91	NONE	
US	5562371	A	08/10/96	NONE	
DE	3307555	A1	13/09/84	NONE	
SE	505742	C2	06/10/97	AT 163380 T	15/03/98
				DE 69408611 D,T	18/06/98
				EP 0641620 A,B	08/03/95
				SE 0641620 T3	
				ES 2113077 T	16/04/98
				JP 7164247 A	27/06/95
				SE 9302885 A	08/03/95
				US 5487626 A	30/01/96
EP	0767024	A1	09/04/97	DE 69621092 D	00/00/00
				JP 2880122 B	05/04/99
				JP 9155640 A	17/06/97
				US 5797710 A	25/08/98
EP	0953396	A1	03/11/99	JP 11309624 A	09/11/99
				US 2001041108 A	15/11/01